A Social-Ecological Evaluation of Conservation Markets for Wildlife

by

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ABSTRACT

Many wildlife species that are essential to human livelihoods are targeted with the aim of extracting short-term benefits. Overexploitation, resulting from failed common-pool resource governance, has endangered the sustainability of large animal species, in particular. Rights-based approaches to wildlife conservation offer a possible path forward. In a wildlife market, property rights, or shares of an animal population, are allocated to resource users with interests in either harvest or preservation. Here, I apply the Social-Ecological Systems (SES) framework (Ostrom, 2009) to identify the conditions under which the ecological, social, and economic outcomes of a conservation market are improved compared to the status quo. I first consider three case studies (Bighorn sheep, white rhino, and Atlantic Bluefin tuna) all of which employ different market mechanisms. Based on the SES framework and these case studies, I then evaluate whether markets are a feasible management option for other socially and ecologically significant species, such as whales (and similar highly migratory species), and whether market instruments are capable of accommodating non-consumptive environmental values in natural resource decision making. My results suggest that spatial and temporal distribution, ethical and cultural relevance, and institutional histories compatible with commodification of wildlife are key SES subsystem variables. Successful conservation markets for cross-boundary marine species, such as whales, sea turtles, and sharks, will require intergovernmental agreements.

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DEDICATION

I dedicate this thesis to my Aunt Carol and Uncle Marc. The two of you have been a

wonderfully supportive presence in my life, especially during the past two years. Your

wisdom, generosity, and warmness have made all the difference to my wellbeing as well

as my academic success. You have fostered in me clarity in taking on challenges and

given me the resolve needed to lead a fulfilling life. Thank you for providing me with a

home away from home.

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CHAPTER 1

Over the past two centuries, species extinctions escalated to 1,000 times background rates, and

large animal species are now among the most threatened (MEA, 2003; Schipper et al., 2008).

The Millennium Ecosystem Assessment identified harvest of wildlife as a significant threat to

biodiversity (Groombridge and Jenkins, 2002). Many of these overexploited species are common

pool resources (CPRs), which, in the absence of an effective regulatory regime, are vulnerable to

the 'tragedy of the commons' (Hardin, 1968). CPRs are shared goods in a resource system with

properties that make it difficult to exclude access. Use of CPRs is substractable, meaning when a

portion is consumed, less is available to others (Anderies and Janssen, 2013). Collective action

measures around CPRs often hinge upon convergence of local land users, hunters, local

government and the international community, all of whom have different interests in the

resource, its welfare, and repercussions of consumption (Dietz, 2003). Institutional gridlock may

occur when the species is deemed both a resource and a nuisance by different parties (Horan,

2004; Bulte et al., 2008). Moreover, CPRs that are migratory species, traversing territories and

possibly crossing multiple jurisdictions, are particularly problematic precisely because of the

difficulty of establishing an effective regulatory regime (Allen, 2010; Cerveny, 2013).

In this paper, I ask whether markets can be used to (a) ensure sustainable use of CPRs involving

multiple jurisdictions and (b) engage stakeholders with non-consumptive interests in wildlife

stocks in wildlife harvest decisions. By employing the Social-Ecological Systems (SES)

framework (Ostrom, 2009) to bring an interdisciplinary perspective to the wildlife markets issue,

I evaluate the plurality of benefits derived from wildlife and develop a comprehensive

understanding of the associated value tradeoffs with a market for animal harvest rights.

Markets for wildlife are a historic part of human society. The formal buying and selling of hide, meat, bone, and more recently tourist excursions have taken place for animals under well-defined property rights (Perrings, 2014). Markets of this form have proven to be an effective agent for conferring economic value to natural resources, although environmental markets are far fewer for wildlife that raise technical and ethical challenges not faced by nonliving resources, like pollution and water (Rademaekers et al., 2011). In fact, markets for cultural ecosystem services, like aesthetic, bequest, and option value (considered as non-consumptive resource values) have failed to emerge (Perrings, 2014). Well-functioning, competitive markets signal to users an approximate level of abundance or scarcity of a resource and give some indication of its importance. Markets embrace the relationships between people and the environment and seek to sustain these flows of goods and energy. Perhaps because of this broad appeal, such solutions are gaining momentum within the public (e.g., the United States Department of Agriculture) and private sectors (e.g., Goldman Sachs and Forest Trends). Granted, economic-based mechanisms are not a panacea to social-ecological dilemmas, but there are settings and species for which they are appropriate. In light of the increased interest in markets to support conservation efforts alongside other management strategies, with this research I explore the conditions under which wildlife conservation markets are possible.

Wildlife conservation markets offer an approach to achieve conservation goals given limited financial resources (Costello et al., 2012; Minteer and Gerber, 2013; Gerber et al., 2014[A, B]). Recently, Costello et al. (2012) proposed a conservation market for cetaceans in which stakeholders could buy and sell the rights to preserve or harvest whales. My use of the term 'wildlife market' in this discussion is distinct from economic or more common understandings of

a market as a rigorous economic-based mechanism. Firstly, it is a derivation of environmental markets. Secondly, the way I use it here is consistent with a burgeoning concept within the conservation community and non-governmental organizations (NGOs). In this context, a wildlife market is a more inclusive application of the phrase referring to the exchange of rights to 'use' animals, whether that be consumptive, such as farming for meat, or non-consumptive, such as photo-tourism. In broader terms, a market is a platform for buyers to purchase property rights to a desired good, and property rights are constrained rights to use a resource (Demsetz, 1967). Actions are said to be constrained because there are socially accepted ways for which property owners can exercise their right. Many institutions for single- and multi-use natural resources alike have adopted property rights arrangements to control harvest, notably forestry, fisheries, and water issues. The question is how can wildlife markets do what other conservation strategies have not, that is allocate resources efficiently to enable the expression of legitimate conservation interests independent of harvest in decision making.

To dissolve mounting social pressure, the Costello et al. proposal would have the IWC allocate secure and tradable rights to the resource among users via a 'whale market' system. A similar system, termed 'catch shares', has already applied to the management of fisheries worldwide, and catch shares have been defended as leading to sustainable outcomes when combined with an effective mechanism to monitor the use of the harvest rights (Fischer, 2010; Biggs et al. 2013; Kinzig et al., 2011; Pinkerton, 1989). With the peril of collapse looming over large, mismanaged fisheries, catch shares have helped overexploited fish populations recover by enhancing the quota, or total allowable catch (TAC) (Wilder, 1995; Tietenberg, 2006; Arnason, 2012; Grafton, 2006; Costello, 2008). The assignment of property rights has circumstantially shown to have

ecological and economic benefits above management alternatives for CPRs (Costello, 2008).

Contracting of rights is one of the most difficult steps in this policy process, necessitating fair

negotiation and distribution (Libecap, 1993). Insofar as these criteria are met, property rights

stand to be instrumental to sustainable management as more natural resources are confronted

with overexploitation and poorly established institutional arrangements (Hilborn et al., 2005).

There have been skeptical responses to this proposal especially in regards to the market

efficiency (Smith et al., 2014) and moral acceptability of commodifying whales, which will be

addressed in detail later.

Since 1946, the International Whaling Commission (IWC) has overseen the intergovernmental

agreement on whale management. It began as strictly a fishing enterprise with the primary

responsibility of setting catch quotas but lacked codified ecological or ethical obligations

(Gambell, 1993). The intention was for stewardship practices set by the Commission to guide

and complement whaling activity at the national level while also safeguarding stocks and

defending against indirect threats to whales. Over time, the autonomy entrusted to member

nations by the IWC failed to translate into sustainable domestic policies and thus led to

overfishing, despite the Commission's admonition (MMC, 1973; Caron, 1995). In light of

depleting stocks, the IWC's Scientific Committee, appointed in 1961, adopted rigorous science-

based stipulations for safe harvesting rates of different whale populations (Gambell, 1993). For

all intents and purposes, this was uncontested until the emergence of the United States (US)

environmental movement in the 1960s, which prompted moral inquiry into the industry and the

practice of culling whales, while simultaneously instigating political tensions between whaling

and non-whaling nations (Scheiber, 1998; Caron, 1995). Later, as a case study, I explore why the

gradual disintegration of the whaling industry seen since the ban on commercial harvest in 1986 calls for a market to regulate harvest.

I first describe the creation of institutions and the conditions that give rise to market regimes in general and how they are applied to the environmental context. From there, I explain how multi-use interests in species are collapsed into natural resource management schemes, motivating my literature review of nonuse values for wildlife. Together, these discourses inform and give context to the three case studies of existing wildlife markets that I qualitatively analyze. In these cases, I draw on the SES characteristics that determine the success of a market mechanism to achieve conservation goals and synthesize these variables to recommend whether such markets are appropriate for the case of marine megafauna[1].

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[1] There are, of course, other important questions to ask about the broader application of wildlife markets, including issues of market efficiency and welfare, the determination of a valid, aggregate price for wildlife, and setting of total allowable harvest levels. These questions, however, are beyond the scope of the present analysis.

CHAPTER 2

ECONOMICS, INSTITUTIONS AND THE EMERGENCE OF MARKETS

Because competition is a cost to society, institutions arise when cooperation shows more promise to enhance welfare or attain higher standards than independent action (Young, 1997). Governance mechanisms, denoted by Young (1994, p. ix), are "social institutions or sets of rules guiding the behavior of those engaged in identifiable social practices." Markets that contract property rights, a particular kind of institution, according to Harold Demsetz (1967), are created when joint net benefits exceed the costs of privatization. In other words, "property rights develop to internalize externalities when the gains of internalization become larger than the cost of internalization" (Demsetz, 1967, p. 176).

Property rights are chosen to settle what Demsetz calls 'scarcity problems' (1964) and may emerge as a result of recognized finite abundance of a shared resource. This knowledge, if accounted for in the market, drives price changes. Resource values hold constant if stakeholder's interests are protected against strategies producing short-term gains at the expense of long-term outlooks. When values in the resource are higher in the future than they are today, rights holders have an incentive to delay exploitation (Alchian and Demsetz, 1973). Future biodiversity loss, for example, might be reduced if the prices of today's species reflected their role in securing lasting, healthy ecosystems in addition to their role in the provision of foods, fuels and fibers. (Fujita, 2012; Assessment, 2003).

Shifts in economic values resulting from technological innovation (e.g., genetically modified organisms that boost economic efficiency) or changes in preferences (e.g., demand for 'luxury'

protein sources, such as beef) may also affect the relative prices of goods and prompt reevaluation of the status quo. Property rights buffer immediate, consumer responses to these changes to avoid overexploitation. In instances where the value of a commodity rises, property rights thwart the inclination to harvest in excess and exhaust the resource supply. Gary Libecap (1993, p. 1) claimed that, "property rights are the social institutions that define or delimit the range of privileges granted to individuals to specific assets." When unconstrained, however, markets can fail and result in poor effects equivalent to that of no property rights (Fujita, 2012). Rights holders will evade the rules in the absence of lawful or social regulation. Hence, policies can achieve higher rates of compliance and better environmental and social outcomes by ensuring that benefits feedback to the actors who directly internalize costs and are capable of exercising good stewardship (Alchian and Demsetz, 1973).

Paradoxically, wildlife species that are most taxing to manage often stir human sentiment and the desire to protect them. Large-bodied, long-lived species, which are typified 'charismatic' animals, are particularly susceptible to exploitation (Schipper et al., 2008). For example, rare African trophy animals are highly valuable in markets, but their vulnerability to this threat is compounded by other exogenous stressors (Johnson et al., 2010). This vulnerability to exploitation is magnified in the case of marine megafauna because they face multiple direct and indirect threats and a relative paucity of biological information is known about them (Schipper et al., 2008; Ressurreição et al., 2011). Marine resources are also open access goods, meaning they are rival and non-excludable. Open access is a situation in which there are no restrictions regarding use of a resource (Anderies and Janssen, 2013). Consumption of fish on the high seas,

for example, reduces the total amount available to other users, which compels fishermen to take what they need before the pool is depleted, leading to 'tragedy of the commons' (Hardin, 1968).

From an economic standpoint, being labeled 'endangered' has been shown to be a dominant influence on willingness-to-pay (WTP) for the protection of a species (Tisdell et al., 2007). In some cases, ethical attitudes toward the moral status of animals or species may lead individuals to assign a relatively high WTP and to favor a complete moratorium on harvest for megafauna. Spash (2000) used social literature to help explain the role of attitudes and ethical considerations in interpreting economic measures of environmental valuation, like WTP studies. He explains that WTP can be interpreted as a proxy for attitudes towards an environmental problem and should not be taken as a purchase of benefits. In other words, a stated payment is a charitable contribution and does not reflect (or is not affected by) scope and details of the provision in question, as an economist might expect (Spash, 2000). Stated behavior based on ethics can also lead to the refusal to make ethical and economic tradeoffs for non-human nature. At the same time, management founded in the recovery of imperiled species has a relatively low return on investment and currently garners inadequate conservation funds (Clark, 1973[A,B]), thus making extinction the most economically efficient option in the short term (Clark, 1973[A]; Martin-Lopez et al., 2008; Martin-Lopez et al., 2009). In the Western world, there is an evident bias towards the protection of charismatic species, yet there is also popular support for broader objectives of biodiversity conservation (Ressurreição et al., 2011).

A rich history of natural resource economics informs and draws on the variety of ways property rights sustain environmental goods. Wildlife markets seek to involve stakeholders with non-

consumptive interests in a stock alongside those intending to harvest. Traditionally the latter has constituted the majority of market participants. Fisheries management is an illustration of this point. This single-use management focus is due to the fact that markets historically have not been designed to accommodate non-consumptive values and only recently has this preservationist position been allowed to compete directly with extractive users within a single market. When this happens, a key question emerges: How can it be ensured that both legitimate interests are recognized in decision making?

To do this, it is important to consider lessons from CPR management that have succeeded by allocating the use of rights to resources with multiple uses. Forest access rights are one of the earliest forms of markets for natural resources. In fact, much of the 'commons' literature centers on the development of cooperative forest use (Ostrom, 1990). Both the species that are targeted and forestry practices themselves, whether to clear-cut or selectively harvest for example, are widely discussed (Clark, 2010). Through time, styles of forest management have differentiated in tune with human interests. What was once just a business with social and technological implications gained an understanding of uses beyond utility (Davis and Johnson, 1987), as forests provide a plethora of benefits to humans everywhere, including carbon sequestration, flood mitigation, habitat for species diversity, fuel, fertilizer, and building material (Kaimowitz, 2002; Calder, 2002).

Similarly, coral reefs are an example of a multi-species, multi-use natural resource. Coral reefs foster many fish communities and invertebrates that rely on coral for habitat or food. These incredibly diverse ecosystems adsorb dissolved carbon and provide coastal protection (Mumby

and Steneck, 2008), but are threatened by disease, climate change (e.g., bleaching from warm waters (Christie and White, 2007)) and human land use decisions that cause eutrophication (Mumby and Steneck, 2008; Hughes et al., 2003). These harbors of sea life draw attention and revenue from tourists; yet, at the same time, tourism has negative impacts on coral reefs (e.g., physical damage by tourists and the catch of non-target fish species (Walters and Samways, 2001)). To balance the interest of conservation and sustainable use, one growing strategy has been to abut marine protected areas to swaths of reef for tourists (Agardy, 1993). Marine protected areas are an SES that can be beneficial to fisheries, biodiversity, habitat restoration and tourism (e.g., Loreto Bay National Park in the Gulf of California).

Though complex issues, both of these examples pertain to sessile resources that have a clear advantage in spatial organization. Non-mobile resources can be partitioned off into zones to easily restrict access with robust enforcement. Forest and coral reef management are accompanied by countless other markets for multi-use species where there are parties that derive benefit from exploiting the stock and others that attribute greater value to the stock persisting. Multi-use planning demands the balancing of these goals to avoid ecological damage and to appease stakeholders. Yet this raises the question: why do people derive benefit from the stock of a resource independent of its harvest?

CHAPTER 3

NON-CONSUMPTIVE VALUES OF WILDLIFE

An extensive volume of research is devoted to measuring and describing attitudes toward non-human species using socio-psychological and economic techniques to capture the best possible comprehensive valuation. The scope is broad. It includes, but is not limited to, aesthetic preferences, consumption practices, historical perspectives, and acquired knowledge in effort to determine people's WTP for the non-consumptive enjoyment of different attributes of wild, living species. Wildlife valuation is at the crux of the resource units and resource users à la Ostrom's SES literature. Though insightful to a degree, the phrasing and contexts of questions engenders some level of non-comparability across contingent valuation studies (Nunes and van den Bergh, 2001). This type of information is relevant to wildlife markets because settling on a conservation strategy involves many actors all with different mental models that shape their policy preferences; and collectively, this can lead to more effective, sustainable management.

Available data suggest that 'charisma' strongly dictates human valuation of non-human species (Lorimer, 2007). Albeit a human projection, charisma stems from a number of biological indices exhibited by a species, including morphology, locomotion, detectability of sound, visibility, and communication methods, among others. These attributes garner public attention and capture human emotion for a variety of evolutionary, social, cultural, and historical reasons. 'Human extensionism' refers to preferences for a suite of phenotypes that grant child-like qualities to a species (Kellert, 1983; Kellert, 1985[A-C]; Kellert, 1993; Kellert and Westervelt, 1983). For example, possessing anthropogenic features, such as a large head and an upright posture, stimulates the human sense of connectedness (Gonzalez-Suarez et al., 2012; Lorimer, 2007). In

direct contrast, species found in clusters, with exaggerated features, irregular proportions, non-responsiveness to humans, and parasitic lifestyles induce negative human attitudes. Beyond the physical and life-history attributes, social aspects of a species also contribute to charismatic designations, which are formed through human interactions in a variety of settings, ranging from childhood encounters to scholarly work (Lorimer, 2007). High perceivable intelligence is also an attractive species quality (Metrick and Weitzman, 1996).

Such perceptions of wildlife are related to nonuse values, which are the benefits derived from wildlife that do not depend upon consuming any part of an animal now or in the future. Whether people intend to see whales or other species and places, nonuse values underlie the desire to preserve them. Indeed there are noneconomic benefits to natural resources that are categorized into existence value, aesthetic value, bequest value, option value, and altruistic value (Freeman, 2003). Nonuse values, according to stated preference surveys, amount monetarily to substantial sums that may be of interest to policymakers.

Czech et al. (2001) found that survey respondents demonstrated a disproportionate affiliation for mammals, birds, and fish over reptiles, amphibians, microorganisms, and invertebrates. Mammals and birds not only appeared on more magazine covers than other taxa, they were the focus of more scientific research, dominated new Endangered Species Act (ESA) listings, and received the most conservation dollars (Clucas et al., 2008; Martín-López et al., 2009; Metrick and Weitzman, 1996). From 1989-1999, 10 species out of 554 were given over half of ESA funding (Doremus, 1997). Fictional species with names that sounded like familiar charismatic creatures drew a greater WTP than their reptilian or invertebrate counterparts (Karaffa et al.,

2012). Most striking about these finding is that the basis of concern is primarily a subjective conception of the species over a factually informed view. Nonetheless, WTP for threatened species has increased since two decades ago, and an endangered status itself evokes concern in people (Richardson and Loomis, 2009; Wallmo and Lew, 2012; Campbell and Smith, 2006), and depending on socio-economic factors, participants of a study in Donana, Spain were WTP for non-charismatic species, too (Martin-Lopez et al., 2007). For these reasons, we can anticipate investment in conservation to grow. In fact, industries fueling conservation activity for whales and other marine megafauna, like whale watching and conservation volunteer programs, are already vigorous. The vital role ecotourism now plays worldwide, particularly in developing countries, motivates biodiversity protection.

Just as species have aesthetic, spiritual, religious, totemic, and inspirational value, they harbor scientific and educational values as well. Private WTP for species conservation follows the same patterns in public funding decisions, meaning species features, such as charismatic attributes, impact science and policy agendas. For instance, intrinsic species features are correlated to volume of data, which is because some species are easier to study and more suitable for experimentation (e.g., small, quickly reproducing species) (Gonzalez-Suarez, 2013). Intrinsic species features, at times, override scientific justification for government spending on endangered species. Emphasis in terms of policy, science, and public visibility has tended to focus on terrestrial systems without sufficient attention devoted to the value of marine environments (Turner et al., 2003). Ultimately, this could be detrimental to conservation goals (Mills, 2012).

To illustrate this point, consider the Endangered Species Act (ESA) of 1973. When deciding on species listings and approaches to take, the ESA precludes cost-benefit analyses that would normally imply how to rationally act. Instead, the ESA favors the use of the best available scientific data to inform legislation. Each state has a scientific authority that provides impact assessments of species recovery plans and mines species data that is evaluated against listing criteria (Doremus, 1997). Kareiva and Marvier state that, "conservationists increasingly use data-based decision science to identify which actions in which places will yield the greatest impacts under the constraint of limited resources" (2012, p. 961). Moreover, the economic implications of policy decisions are increasingly more important in determining the strategy that best balances social and ecological tradeoffs. Future studies and policies should widen their analysis to different taxa and understudied regions (Ressurreição, 2011). Otherwise, with these blinders, policy runs the risk of deleterious biases and the disintegration of ecosystem-level perspectives.

Status quo conservation agendas have a narrow focus on flagship and high-profile species, hindering the advancement of scientific knowledge at the species and ecosystem levels. We are less able to calculate an accurate value for biological goods about which relatively little is known. Holistically speaking, we lack a comprehensive understanding of biology's true worth (Ehrenfeld, 1988). An example of this is bioprospecting, which is "the search among the genetic codes contained in living organisms for the development of chemical compounds of commercial value in agricultural, industrial, or pharmaceutical applications" (Nunes and van den Bergh, 2001, p. 210). Intrinsic and moral values are also important facets to wildlife valuation, though they are notoriously difficult to describe in the form of a figure or value that translates well across disciplines, like ethics and economics.

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The attribution of intrinsic value (IV) to nonhuman species and ecosystems reflects a non-anthropocentric view of nature that, when used constructively, can complement the instrumental valuation of biological resources. The concept of IV refers to entities that have value in-and-of themselves, that is, value independent of human interests. Another way of stating this is that moral consideration must be extended to entities said to possess IV (Callicot, 1984). There are, however, different theories of IV. On the "weaker" account, people assign intrinsic value to nature (i.e., the value is anthropogenically sourced). IV is, in this case, simply one of the many values people can and do ascribe to nature (i.e., they can value nature for its own sake, or more anthropocentrically, that is, for its direct and indirect usefulness). A "stronger" theory of IV, however, holds that moral worth is something that nonhuman entities and/or systems have independent of any human valuation (Soulé, 1985).

Much debate has taken place in the philosophical and conservation literature over how intrinsic value enters into decision making (e.g., McCauley, 2006; Justus et al., 2009). For example, if the interests of two species (each of which is claimed to possess IV and thus be morally considerable) come into open conflict, which interest should win out? Despite the allure of IV arguments among conservationists, there is typically no prioritization framework offered that could produce a clear answer to such practical questions of moral judgment (Justus et al., 2009). Nor is there consensus regarding the holders of IV. Some philosophers (e.g. animal rights theorists and some biocentrists) argue that IV can be ascribed to individuals, while others (holistic biocentrists or ecocentrists) suggest that it can be attributed to whole systems. The apparently incommensurable nature of intrinsic and instrumental values and the ambiguity

surrounding the focal species or system possessing IV greatly complicates the appeal to IV in conservation decisions.

This does not mean, however, that commitments to the intrinsic value of biodiversity have no place in conservation planning and practice. Minteer and Gerber (2013) consider the moral tradeoffs of using market tools to protect wildlife. They suggest that these ethical arguments are an imperative component to the conversation, as the embrace of intrinsic value leads to a broader conception of an entity's value. These commitments also play an important role, they argue, in motivating the broader policy goal to conserve species and protect ecosystems and so are valuable for this purpose. Ethical reasoning, moreover, does not preclude economics from having a role in conservation efforts. One possible accommodation, then, is to consider IV-of-nature arguments as providing a moral foundation for the wider policy goal of wildlife conservation, with economic instruments (e.g., markets) serving as one set of alternative means to achieve this end (Minteer and Gerber 2013)

CHAPTER 4

CASE STUDIES

THE SOCIAL-ECOLOGICAL SYSTEMS FRAMEWORK

To learn more about the efficiency of wildlife markets as programs to protect species through

regulated access and whether markets, like a catch shares model, are an appropriate approach to

conservation, I employed the SES framework. This analytical framework is useful for identifying

differences across species, people, and governments. I use the framework to understand rather

than eliminate system complexity in my case studies.

The SES conceptual framework is a product of Elinor Ostrom's seminal work on human-

environment relationships that extends Institutional Analysis and Development to studying

governance in ecological systems (Ostrom, 2007). It emphasizes the interconnected nature of

multiple sets of capital and clearly shows how flows of information or resources are a cyclical

process, involving biophysical elements, actors, governance structures, interactions, and

outcomes (Anderies and Janssen, 2013). Ostrom intended for the SES framework to be adaptable

and scalable, and though it has been heavily cited for community self-organization cases, it is

entirely applicable and useful for broader CPR dilemmas (Agrawal, 2002; Anderies and Janssen,

2013). The value of this approach is that system components and relationships between them

may be isolated to identify weaknesses in the system, to define SES connections with public

policy, and to understand how this leads to policy change.

Out of her cross-case comparisons, Ostrom deduced the SES subsystems and second-tier

variables for governing environmental resources (Ostrom, 2009) (Figure 1). The four core

subsystems of the SES are the resource units, resource system, governance system, and users. Within those, the second-tier variables act as an introduction into the public policy process because this process is directly linked to the social and ecological contexts in which it is embedded (Figure 2). I use the SES subsystem variables to retain the complexity of my case studies, as Ostrom encourages, but also to distill them into their component parts in order to determine causes of success and challenges. For readability purposes, in my descriptions I collated features of the SES framework that are tightly intertwined into subsections, such as 'Users' and 'Resource Units and Resource System'. These variables inform my analysis of a potential whale conservation market. Several cetaceans are folded into one study because, although biologically diverse, whales are all managed under the purview of the IWC. Therefore, I chose to analyze the institution rather than separate populations.

Beyond the novelty of wildlife conservation markets, application of the SES framework is an important contribution to the field of wildlife management. Markets are playing an increasing role in CPR management, and Ostrom's coupled systems perspective is an appropriate one to adopt for evaluating their potential. Wildlife markets are examples of coupled SESs. At a scholarly level, Ostrom touted the SES as a means to merge disciplines, such as resource economics, policy studies, and sociology, which normally use different rhetoric and concepts (2007). The SES approach was most appropriate for this evaluation because wildlife markets are at the crux of multiple disciplines, making it challenging to select an analytical framework from any single one of those root disciplines. After an SES analysis, there is potential to go more in depth with the literature most pertinent to research findings from the initial analysis, and this was an attractive feature when selecting a framework.
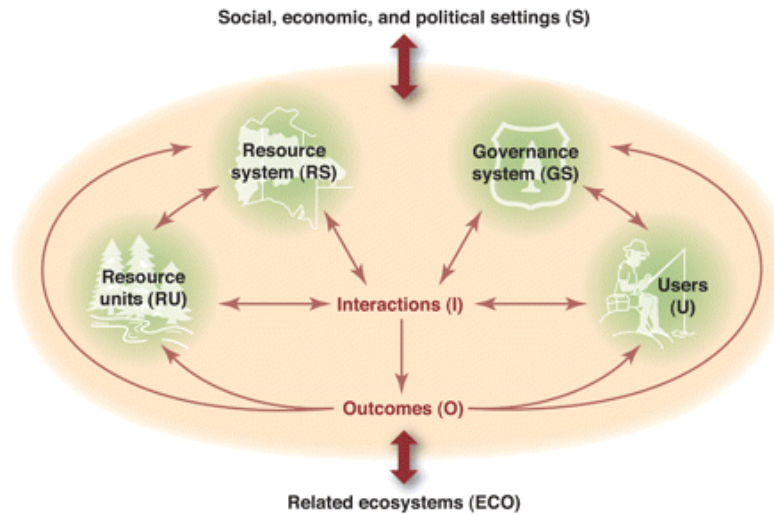
Figure 1. Ostrom (2009) social-ecological core subsystems in a framework

Figure 2. Ostrom (2009) second-tier variables for analyzing social-ecological systems

CASE SELECTION

I drew from a review of the literature cases of species conservation and management that employ, at least in part, a market mechanism. Here, I use the SES framework to examine the cases of 1) Bighorn sheep in the US, 2) South African white rhinos, and 3) Atlantic Bluefin tuna. Economic-based systems of wildlife management, in particular, operate throughout the world in diverse institutional and biophysical settings. Over time this literature has produced a dataset relevant to understanding when and which populations are amenable to such institutional arrangements. These data also give a sense of the conditions under which rights-based management can optimize social and ecological gains. A dialogue about the role of property rights reverberates throughout these cases, and best practices can be transferred between contexts. Additionally, each of the cases shares features with international whale management, which make them appropriate choices for informing the formation of a whale conservation market.

Current wildlife markets function under a variety of social, biological, and institutional settings, so they cannot be compared directly without a few assumptions. Despite the distinct lineages, physical attributes, and human perceptions of each (Czech et al., 2001; Czech et al., 1998), the species share a common feature: all have been threatened due to insufficient management practices or overharvesting. My criteria for choosing these three cases were also based on each being similar to whales on some level. Firstly, the policy history of Bighorn sheep runs parallel to that of whales. These animals were historically hunted by indigenous and later colonial people for products, such as their hide and meat. Then, when populations became critically low, hunting was halted. Since then, hunting Bighorn sheep has been reinstated even though some

subpopulations are considered endangered. The IWC has followed a similar path of regulation changes. Secondly, rhinos and whales both have high profile, iconic statuses that render them targets of the very public and principled ethics/ economics debate. Finally, Bluefin tuna are pelagic, endangered, and coveted for their meat. Catch shares are a well-known example of wildlife markets that a whale conservation market closely models, so it was a natural (and imperative) comparison to make in this analysis.

Furthermore, the case of white rhino management in South Africa depicts the bigger situation of game management in South and East Africa. Similarly, with recreational hunting in North America, I use Bighorn sheep to illustrate how hunting performs as a conservation strategy for an at-risk species. To avoid losing site of the goal to diagnose the market, I intentionally narrowed to certain species and countries to allow for a more depth discussion. All of the cases are megafauna, but there is also diversity: Bighorn sheep fall within one jurisdiction, white rhinos may cross multiple without physical barriers, and Bluefin tuna occupy multiple jurisdictions as well as international waters. In addition, Bighorn sheep and Bluefin tuna are endangered while white rhinos are near threatened by the International Union for Conservation of Nature (IUCN) criteria.

CASE 1: BIGHORN SHEEP IN THE UNITED STATES

Users and Interactions. An integral part of the North American model of wildlife management is recreational hunting, which entails eliminating predators to regulate populations and ecosystem impacts. From the colonial era, parks and reserves were the main strategy for protecting nature, but this view later became inclusive of humans. The hunting tradition spawned

from recognition that human use of wildlife is inevitable, especially since recreation and socio-cultural purposes displaced the subsistence aspect of hunting as the US modernized (Loveridge et al., 2007). In the late 19th century, Theodore Roosevelt was a powerful figure in carving out the role of sport hunting of species, like Bighorn sheep (*Ovis canadensis*), Canadian geese (*Branta canadensis*), and black bear (*Ursus americanus*) in the country's conservation efforts. In 1887, Roosevelt and George Bird Grinnell, a writer of naturalism and anthropology, founded the Boone and Crocket Club (B & C Club), an organization that synergized the dual roles of hunter and conservationist. It also championed the creation of several national parks and landmark, science- and funding-related legislation for the protection of land and wildlife resources (e.g., Timberland Reserve Bill, National Wildlife Refuge System Act, Federal Duck Stamp Act). Around this time came the formation and development of federal land management agencies (e.g., US Fish and Wildlife Service (1940), US Forest Service (1905), the National Park Service (1916)) and wildlife conservation organizations (e.g., National Audubon Society (1905), National Wildlife Federation (1937), and Ducks Unlimited (1937)), which can be attributed, by no small measure, to the involvement of the B & C Club (Boone and Crockett Club, 2014).

Among its numerous conservation achievements, the Club established a set of principles guiding the sustainable and ethical practice of hunting, one of which is fair chase. Fair chase outlaws the practice of 'canned hunting,' or shooting animals in small enclosures in which they have no chance of escaping the hunter (Lindsey, 2008). Today hunting associations, in order to remain legitimate, also foster positive relationships with scientists and NGOs, including the IUCN (Baldus et al., 2008). These partnerships facilitate the Club's primary initiative today of maintaining a scoring and data collection system by which North American big game animals

may be objectively measured and tracked as a gauge of successful wildlife policies and management. Such records have been vital for assessing changes to populations over time.

The legacy of Roosevelt and Grinnell was picked up later by foresters, game managers, and environmentalists, like Aldo Leopold. In his early work, Leopold was mostly concerned with boosting game availability, but his mature ecological and conservation interests rooted from a 'land ethic' in the 1940s that would influence modern conservation missions of many organizations in the ensuing decades. The Leopoldian ethic promotes wildlife and ecological protection, but it also recognizes the goal of sustainable use. In this sense, Leopold's work represented a significant evolution from the narrower projects of resource managers, like Gifford Pinchot, who tended to prioritize more utilitarian motivations (Callicott, 1990). At the same time, the 'sustainable use' model remains a significant feature of contemporary conservation science and policy. The Convention on Biological Diversity, for example, defines sustainable use as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations" (UN, 1992). Decades after the groundwork was laid by early conservationists, the ethics of hunting remains an essential piece of the conversation. Fundamentally, some people would never be able to take a life no matter the hunter's objective and animal suffering. "The welfare of animals at an individual level often conflicts with conservation of the species at a population level," and even non-killing interactions with animals can invoke stress (Loveridge et al., 2007, p. 225). Such moral commitments are accompanied by other intangible, non-consumptive values of hunted species.

At present, federal and state agencies, private landowners, individual recreationists, and park

visitors comprise the direct users and managers of Bighorn sheep. The Desert Bighorn Council

Transactions, a multi-disciplinary group formed to deliberate on the shortage of information on

bighorns, started in 1957 and now produces an annual report (Monson and Allen, 1980). Then in

1977, the Foundation for North American Wild Sheep became the primary wild sheep

conservation organization in the world. These organizations hang in the balance of social and

ecological objectives, embracing the notion that people cannot be removed from wildlife

management. Hunted species are often kept at levels deemed acceptable by the public and most

profitable in terms of management costs and benefits (Kaltenborn et al., 2013; Schuhmann and

Schwabe, 2000). Access permits allow scientists, citizens, and managers to engage in activities

that balance use and species conservation. In 2011, 13.7 million people, 11.6 for big game,

participated in hunting and/ or wildlife viewing (US Fish and Wildlife, 201). Understanding the

consumptive and non-consumptive values helps determine how to go about attaining the optimal

population size according to human preferences and needs.

Resource Units and Resource System. Bighorn sheep are herbivorous ungulates that

boast two heavy, curled horns. Bighorns congregate in herds of five to fifty that are scattered

across the western US, Alberta and British Columbia, Canada, and northern Mexico. In the US,

the population is subdivided into 10 subspecies, which can crudely be differentiated into desert

and mountain Bighorn. Their ranges, principally on federal and protected land, do not overlap

geographically and, therefore, do not intermingle (Festa-Bianchet, 2008). The entire population

is listed as 'of least concern' by IUCN criteria while the Rocky Mountain subspecies was added

to the Endangered Species List in 1999. From 1999-2011, numbers went from just over 100 to about 400 (California Fish and Game, 2014).

These separate populations have adapted behavioral idiosyncrasies in response to different environmental conditions, but they share common features as well. Though the population spans multiple jurisdictions, single herds are very philopatric, returning seasonally to the same location, and are unlikely to cross national borders. These animals are impressive aesthetically because of their physical stature and ecologically for their ability to scale rocky, steep terrain. Migrations of mountain Bighorn entail thousands of feet of elevation gain between winters at low elevation and summers in higher alpine areas (California Fish and Game, 2014). Bighorns can be found in 30 US national parks where they are used in non-consumptive practices, like tourism, guiding, and sport hunting, although poaching is also a threat. Hunting rates were once much higher, which contributed to the near exhaustion of the population (Monson and Allen, 1980). Early 19th century, up to 2 million bighorn were estimated to live on the continent. Numbers fell with westward expansion of American hunters and the introduction of domesticated species that reduced forage (Monson and Allen, 1980).

Today encroachment by human development, fragmentation, and reduced genetic diversity are the main anthropogenic threats that constrain population growth and disrupt migration patterns (Festa-Bianchet, 2008). Poor connectivity between habitats leads to rapid population decline and genetic diversity loss in this species (Jorgenson et al., 2007). Disease, throughout the late 20th century into today, has also been a major stressor on population viability, especially for herds in proximity to livestock (Gutierrez-Espeleta et al., 2007). Moreover, Bighorn sheep develop

slowly and have low productivity. Females give birth to a single offspring per six-month

pregnancy. Young sheep have variable survival rates but adult survival is high (California Fish

and Game, 2014). Due to recovery programs implemented by 14 state agencies, involving efforts

such as relocations and supplying water to desert Bighorn (Festa-Bianchet, 2008; Arizona Game

and Fish, 2014), abundance has risen.

The horns of rams are larger than those of females and are a popular trophy sought by sportsmen

(California Fish and Game, 2014). In the wild, these horns are used for fighting, feeding, and

protection. One recurring admonition of hunted game animals is that human are driving artificial

evolution or 'genetic manipulation' by removing fit phenotypes from the population (Baldus et

al., 2008; Festa-Bianchet, 2009). Coltman (2003) conducted a study on rocky mountain Bighorn

sheep, concluding that selective pressures from hunting have altered traits and fitness over time,

reducing population performance. It is countered that environmental factors, including nutrition,

determine fitness and that females, which cannot be hunted, contribute half of the genes (Baldus

et al., 2008). To allow more time for fit males to spread their genes, age parameters are often

accounted for in trophy scoring. In other ungulates trophy hunting may disrupt territorial and

mating behavior, skew sex ratio, and reduce fecundity (Loveridge et al., 2007). A study on sheep

response to human interactions and found that in general sheep avoided roads and reaction was

most intense when neared by a person on foot over motor vehicles (Papouchis et al., 2001).

NGOs are working with Wyoming, Montana, and Idaho state agencies, the US Forest Service,

and the National Park Service to examine how interactions with other species, like people,

wolves, and nonnative mountain goats could impact sheep. As such programs demonstrate, the

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sport hunting industry around Bighorn sheep is backed by a robust institution that affords protection and support for using wildlife sustainably.

Governance System and Outcomes. In 1917, hunting of Bighorn sheep ceased because of low population levels in Baja California Sur, which later forced a band throughout the country in 1922. The first authorized hunt was reinstated in 1969, and the annual season continued regularly until 1990 when a presidential decree cited insufficient biological knowledge on Bighorn sheep for hunting to persist.

Sport hunting in the US is a well-established system of regulation, enforcement, and protection. When unregulated hunting can cause ecological damage, but when regulated, it can contribute to species recovery, as happened with wild turkey (*Meleagris gallopavo*) and the beaver (*Castor canadensis*) (Loveridge et al., 2007). In states in which Bighorn sheep are found, conservative numbers of hunting tags are distributed to licensed hunters and all states require that trophies be marked for identification as a way of tracking the origin of animals and penalizing poaching (Festa-Bianchet, 2008). Agencies claim that only when deemed safe to the population are permits granted. Indeed, the sale or auction of a single tag can be quite lucrative, as people are willing to pay more for better trophies (Festa-Bianchet and Lee, 2009). Hunters spend lavishly on costs associated with their practice. Expenditures by US hunters in 2011 totaled $33.7 billion, and hunters have paid up to $160,000 for a single sheep (Loveridge et al., 2007). An 11% tax ordered by the Federal Aid in Wildlife Restoration Act (1937) on ammunition and equipment serve many purposes, like hunter education and safety courses, wildlife conservation, purchasing wildlife refuges, and social improvement projects. What is more, there is low leakage of funds.

Grimm (2002) submits that investments in infrastructure are considerably lower for hunting reserves than photo-tourism and hunting areas have slowed poaching and the displacement of wild land with agriculture.

In some cases, hunting reserves can be an alternative to national parks because they can be located in remote, less scenic areas without requiring sophisticated management and infrastructure (Baldus, 2008). Land owners are responsible for good stewardship and they have an incentive to do so since clientele and revenue are dependent upon a healthy, attractive population. Sometimes good land management and wildlife conservation are joint endeavors (Loveridge et al., 2007). Because Bighorn sheep are in rugged terrain, it takes a dedicated hunter to organize a trip and track down prey. This investment may weed out haphazard shooting incidences or unskilled hunters from depleting ram, especially to any excessive degree (Russell, 1973). Species are also protected under the Lacey Act of 1900, ratified by the US with the objective to prevent non-native introductions and to protect game species. The act makes it illegal to trade or transfer wildlife, fish, and plants that are taken by unlawful means or that are prohibited to be taken from one territory to another (US Department of the Interior, 2011). Overall, the US recreational hunting industry has the clout and experience with the backing of sufficient ecological evidence to adequately regulate sustainable use of wildlife.

CASE 2: AFRICAN WHITE RHINO MANAGEMENT IN SOUTH AFRICA

Resource Units and Resource System. White rhinos (*Ceratotherium simum*) inhabit four countries: South Africa, Namibia, Zimbabwe, and Kenya. Their habitat features thick bushes and flat terrain of the savannah, and their continual grazing on short grasses alters the

surrounding ecosystem (Waldram et al., 2008). There are approximately 20,000 white rhinos in South Africa and the species is considered 'near threatened' by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Biggs et al., 2013). The main threats to the white rhino population are human encroachment, habitat degradation, poaching, and the indirect effect of low captive fecundity rates on population conservation (naturally, a mature female will give birth every two to three years) (WWF, 2014; Patisaul, 2012). White rhinos have two horns that are highly coveted. Most of this species resides in national parks, where tourism is popular, or on game ranches, which sell rights to hunt rhinos and other species on privately owned land.

Governance System and Outcomes. The history of rhino management is one familiar with a wide variety of conservation tactics, some of which are economically oriented. A new use for agricultural land called 'game farming' or 'game ranching' became prominent in the 1960s partially out of fear of shrinking wildlife abundance in national parks (Boyes, 2013). Unlike many other countries in the region, South African game ranches were the advent of privatization of formerly public wildlife resources, a change that was illustrative of the profitability of stewarding wild lands (Duffy, 2000). They were stocked with the big five game species (lion, elephant, Cape buffalo, leopard, and rhinos) for meat and sport hunting. At the time, admission into state-owned parks, which came about earlier in the century, was expensive and precluded the entertainment of a broader populace. To earn more revenue, the government subsidized permits for rhinos, allowing parks to sell surplus game to private individuals who could also relieve some of the financial burden from the state. Commercial hunting of rhinos was forbidden by CITES in 1977 (Biggs et al., 2013; Inskipp and Gillett, 2005), but in 1985, rhinos were legally

auctioned off, collecting a high profit compared to selling hunting permits alone. By 1990, rhino auction profits increased by ten-fold to an average of $50,000, and in 2001, South African game farming earned $44 million (Martin, 2012; Lindsay et al., 2008).

Countries like South Africa also chose to capitalize on tourism. Because of these two opportunities, game ranching and tourism, land stewardship became a profitable venture (Duffy, 2000). Parks offered photography, tours, and animal observing that today are booming. Photo-tourism also comprises a large portion of GDP, however photo-tourism tends to dissipate during political turmoil and it is not possible in some areas that can easily accommodate hunters (Loveridge et al., 2007). Besides safaris and wild game, another market for African wildlife is far grimmer. The illegal, underground trade in animals and animal-derived products is pervasive and takes many forms, from legal to illicit, formal to informal, small scale within communities to trafficking that spans continents, and for creatures as diverse as Chinese pangolins, orangutans, and polar bears (Oldfield, 2003). Illegal wildlife trading is an $11 billion annual industry (Allen, 2012), which suggests the prominence of this global issue.

Black market demand for rhino horn stabilized in the 1990s after its surge from the 1960s-80s because of generational shifts in preferences and several decade's worth of cultivating environmental stewardship and compliance within the community (Martin, 2011). However, a recent resurgence has prompted stricter regulations. Today, a permit is required for any right to a rhino (Conrad, 2012). As of 2011, live rhinos were valued at $780 million on the black market (Martin, 2011). About 80% of world's rhinos are in South Africa, and many are in Kruger National Park where more than half of South Africa's rhino poaching incidents take place. There

were 13 individual losses in 2007, 333 in 2010, 448 in 2011, 668 in 2012, and ostensibly over 1,000 in 2013 (Smith, 2014). As a result of the high price of absconding illegal wildlife products, poaching rates rose concurrent with the cost of rhino horn in illegal Asian markets, where most of the demand originates. Botswana, a country professing to never have had a rhino poaching incident, will receive possibly 100 of South Africa's rhinos in effort to curtail population decline in that country.

Illegal wildlife trafficking has had an impact on human communities as well as species conservation. Black markets drain potential money from communities, finance transnational crime and even terrorism, and undermine the stability and opportunities of countries from which targeted species originate. Poachers can also pose a danger to rangers tasked with protecting wildlife. These crimes mostly occur in places where corruption and political unrest compound the conventional challenges of government (Conrad, 2012). Last year, the US ratified a presidential task force to enhance federal laws directly related to the trafficking of elephants and rhinos, underscoring the importance of this issue to human security (Eilperin, 2013). It is also a focal project for some development and environment NGOs to stymie this clandestine industry. Periods of mitigation in wildlife poaching have been possible due to the efforts of organizations like TRAFFIC, a wildlife trade monitoring network affiliated with World Wildlife Fund (WWF) and IUCN. TRAFFIC focuses on monitoring and sanctioning in Asia and Africa, and it is the prevailing example of command and control (WWF, 2012). The key to reversing the governance struggle over African big game is greater attention to Asian countries from where demand is coming because poaching and the lucrative illegal trade are driving the imperilment of rhinos. With this tempered, South Africa might be able to have sound resource governance.

Users and Interactions. In this SES, the social setting is comprised of affluent trophy hunters typically from out of country, South Africans running the parks in the service industry and serving as park rangers and knowledgeable staff, and private game ranch owners. White rhino management is different across national contexts. All African countries condemn poaching, but they vary in whether consumptive uses are deemed acceptable as a means to fund wildlife conservation. Kenya's model of conservation contrasts with South Africa in this way. Instead of game ranching and sport hunting, Kenya opts for poisoning horns and installing microchips to trace rhinos and monitor the population. In December of 2013, The Kenyan president signed the Wildlife Conservation and Management Act (No. 47 of 2013). The new act, mobilized by the state-run Kenyan Wildlife Service, imposes a fine of roughly $230,000 and a life imprisonment sentence for poaching threatened species. This bold proclamation is a continuation of the country's rigorous, no tolerance approach to the protection of wildlife. Since Kenya's push for commercial bans for all big game species in the 1970s, wild game populations have declined by 60% and, for wildlife overall (carnivore and herbivore species), that number is 70% in the past 33 years - trends that are attributed to human activity. One side argues trade bans have led to sharp falls in wildlife populations (Ogutu et al., 2011) while the opposition, like the International Fund for Animal Welfare, retorts that numbers have actually climbed (Martin, 2012). In truth, downward trends in wildlife plague all of South and East Africa.

As this polarizing debate illustrates, some conservationists and wildlife advocates are not supportive of this kind of commodification of wildlife. South Africa's adoption of trophy hunting in lieu of a stand-alone tourism industry was a practical move that had to be justified to parties antagonistic towards the idea that wildlife could be a commercial resource. Opposition to trades

in wildlife claim that sacrificing an individual animal is an ethical violation that tarnishes the value of nature and effects ideas on what actions towards non-human life are permissible. If it is okay to lose one, at what number do we stop? Prices for wildlife may be biased against non-anthropocentric stances because they are forced to make an economic tradeoff with wildlife when one may not exist for someone believing environmental values transcend monetary valuation (Spash, 1997).

Actors, such as the WWF and Humane Society International, who promote the protection of wildlife and wild lands, reject environmental markets. Rather, they prefer trade bans, which are intended to stabilize and maintain secure populations by forbidding any harm to wildlife. They caution that allowing trade and "one-off sales" will misleadingly condone the ownership of these products, thereby stimulating illegal trade and additional poaching, a concern that is even more disconcerting than the animal rights view (Fisher, 2004). One-off sales are short-term sales of confiscated or abandoned wildlife products and are supported by IUCN, CITES, and the US Fish and Wildlife Service. Bulte and van Kooten (1999) and later Rivalan et al. (2007) found a positive relationship between up-listing a species (the equivalent to a trade ban) and the number of illegal trade transactions (JE and JA, 2007). In contrast, a separate study showed that there is correlation not causation between one-off sales and elephant mortality in Zimbabwe and Kenya, countries that support and oppose trade bans, respectively (Bulte, 2007). The back-and-forth has left the debate on an ambiguous note but reinforces the need for broad stakeholder participation, which will reveal the plurality of interests invested in the wildlife population for the best attempt at an acceptable path towards sustainable use.

Attitudes towards game animals espoused by African locals are generally attributed to human-wildlife conflict, cultural influences (e.g., rural poor believing wildlife attacks are elites actually controlling or acting as the animals), and environmental factors (e.g., lack of alternative food sources) (Dickman, 2010). This is a narrow description of how Africans view wildlife that does not address the nuances in their attitudes, though it is one part of human-wildlife relationships in the region that is important to the study of the market for white rhinos. Because many locals are pastoralists, their concerns are related to how to reap the most benefit from their land (Martin, 2012). Just as coyotes, wolves, and other predators are a perturbation to US farmers and homeowners (Suryawanshi et al., 2013), landowners in southern Africa have negative attitudes towards surrounding megafauna. Tigers, rhinos, and elephants cause harm to livestock and game, raid and damage crops, transmit disease, and sometimes attack humans (Dickman, 2010). Community members will often retaliate by opting for lethal control, so to build tolerance, the financial benefits accrued from hunting and tourism must be proportional to or greater than the loss from wildlife damage (Loveridge et al., 2007).

Alternatively, several conflict resolution strategies have been tested (e.g., physical separation, guarding assets, habitat use and modification, behavior modification of species or people, buffer resources, and non-lethal control) (Dickman, 2010). Mitigating the exaggerated response and promoting conservation requires a system that accommodates the interests of a variety of stakeholders to create an incentive structure for saving animals rather than eliminating them (Trebilcock et al., 2012). Tourism and trophy hunting markets are fueled by affluent foreigners that hold different views from locals. A possible way to have better success at rule enforcement

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requires clearly defining, communicating, and resolving disparate attitudes and expectations of the locals with the objectives of state and private actors enacting the rules.

CASE 3: ATLANTIC BLUEFIN TUNA

Resource Units and Resource System. There are several stocks of Bluefin tuna but, for the purposes of this narrative, I chose to focus on Atlantic Bluefin (ABFT) (*Thunnus thynnus*), which is managed as eastern and western stocks. Together, this population comprises the bulk of the species (IUCN). ABFT are large, pelagic predators (>3 m and up to 900 kg) (Fromentin and Powers, 2005). Like many of the world's fisheries, the Atlantic Bluefin stock is being decimated by industrial-scale fishing, mostly driven by commercial fish farming in the Mediterranean, US, Canada, and Japan (IUCN). They are particularly profitable for their demand in sushi, but are also heavily subject to bycatch by deep sea long-line fisheries (Fromentin and Powers, 2005; Teo and Block, 2010). Because fisheries are widespread and fishing intensity varies by area, control is difficult (ICATT, 2005). Quotas, or total sustainable harvest levels, have been enforced since 1982, yet the stock has suffered precipitous decline in just over three generations, reducing biomass by at least 51%. It is now considered endangered, even though current stock estimates are uncertain (Fromentin et al., 2005). Uncertainty, however, would not be justifiable reason to side-step cautionary or more stringent management decisions (Myers and Worm, 2003).

Individual ABFT have far-ranging dispersal patterns (>2000 km in a single season) between locations in the Caribbean and up and down the Eastern Sea Board (Block et al., 2011). Adults, quite rapidly, are able to travel vast distances to spawn in the Gulf of Mexico, to which they demonstrate site fidelity, and breed in the Mediterranean Sea (Block et al., 2001). Though they

can tolerate large temperature gradients, Bluefin are sensitive to environmental fluctuations and susceptible to the near-term impacts of global climate change (Fromentin et al., 2005). Additionally, life history attributes, like "slower growth, later maturity, shorter spawning season, larger size and longer life span…make ABFT more vulnerable to exploitation than tropical tuna" (Fromentin and Powers, 2005, p. 290).

Users and Interactions. From its inception, fisheries management was looked upon in a different light than other forms of wildlife management. A fish is a single-use resource, and the foremost interest is in its meat. Because fish are not considered charismatic and are a dietary staple for 1 billion people (UNEP 2011), with very little debate, they have namely been a good for consumption. International commercial fishing fleets are the main users in this system. Harvesting level and effort of these users are based on the price and demand of tuna on the market, and often lobbying takes place to raise fishing quotas (Grafton, 2006). Consistent and heavy consumer demand for predatory fish creates an incentive for industries to exploit, which is the nature of open access CPRs. Many global fisheries are on the brink of collapse because of singularly economic-based incentive structures that have encouraged short-term rewards over sustainability (Sanchirico and Wilen, 2007; Costello et al., 2008). As will be discussed next, the best situation to mitigate extirpation of large fish species is to have cooperation and collaborative agreements.

Governance System and Outcomes. Most US fisheries are managed by regional councils under the umbrella of the National Marine Fisheries Service (NMFS), which as of 1990, the Secretary of Commerce has overseen. The Highly Migratory Species (HMS) Management

Division of the National Oceanic and Atmospheric Administration (NOAA) regulates Atlantic HMS. For HMS, like Bluefin tuna, institutional agreements are challenged more so than a near-shore fishery with defined boundaries. HMS are defined as "creatures that are believed to undertake extensive migrations and that carry individuals through many coastal zones as well as the high seas throughout their life" (Hilborn and Sibert, 1988, p. 36). 'High seas' refers to international waters, meaning territory beyond 200 nautical miles off coasts (UN, 1982). That a single stock of Bluefin tuna may cross paths with fishermen from a number of nations highlights the absolute need for international agreements (Sandler, 2004). Because of the large spatial scale of tuna, layers of governance with congruent policies are the best attempt at ameliorating 'tragedy of the commons'.

Bluefin fishing is banned in the Gulf of Mexico, yet they continue to be caught accidentally in those waters. The height of this activity occurs during spawning season, January to June, a troubling notion given that tuna exhibit strong habitat preferences for these areas (Stanford University, 2010). High seas fisheries have yet to acknowledge the sensitivity of tuna at site- and time-specific life stages by siphoning access and implementing gear restrictions (Teo and Block, 2010). Fisheries mismanagement goes beyond depletion of a single species; removal of marine predators has cascading ecological impacts on food web dynamics (Block et al., 2011).

In 1966, International Convention for the Conservation of Atlantic Tunas (ICCAT) was signed, establishing an intergovernmental organization for sustainable management of several tuna species. In this capacity, ICCAT conducts stock assessments on different species of Atlantic tunas, swordfish, and billfish. It has been widely criticized for failing to deliver on its mission to

resuscitate stocks, sustain fisheries, and deliberate quotas to maximize harvest yields since alarmingly low population levels were detected in 1950 (Hilborn and Sibert, 1988). Furthermore, ICCAT does not have the full participation of nations bordering the Atlantic. "Most Latin American nations have withdrawn from [the agreement], and their own fishermen are essentially unregulated in their own waters" (Hilborn and Sibert, 1988, p. 31). While signatories provide biological and economic tuna data annually, non-member nations are not under contract to regulate fishing in compliance with the organization's standards, and there are no formal sanctions to apprehend defection (Fromentin, 2005). These discrepancies are a poignant juncture for HMS, like Bluefin tuna and whales.

CASE 4: POTENTIAL FOR A WHALE CONSERVATION MARKET

Users and Interactions. While all commercial whaling is banned and few stakeholders still have a vested interest in preserving the age-old activity, whaling persists in three exceptional cases: among aboriginal subsistence communities for which there are stipulations to confirm this status, whaling with a scientific permit, and whaling under the objection clause. All exceptions are liable to a quota (IWC, 2014). Though IWC meetings are inclusive, involving broad stakeholder participation, the organization is fully aware of its current compromised circumstances and regularly convenes to address them (The RMP, 2013). Because Western countries have a strong voice in the IWC, their inclination towards whale preservation colors the political landscape (Hirata, 2004). Animal rights, certain conservation activists support the widely held claim that whales are superior entities worthy of moral respect. On the other hand, whales are heavily sought after among select groups worldwide for their economic and cultural value. Some subsistence communities (recognized by the IWC in Denmark, Russia, St. Vincent

and the Grenadines, and the US) regard whales with reverence but also continue the tradition of killing them for nutrition and to sustain culturally significant ceremonial hunts (Reeves, 2002).

Controlled harvest of aboriginal whaling has effectively met community demand and ecological objectives of replenishing stocks (Roman et al., 2013). The moratorium is unsettled, however, mostly because of commercial industries in Iceland and Norway and scientific whaling practiced by Japan. Recent studies affirm that Japan contributes no substantive data or scientific insight to the field (Mangel, 2013). Reportedly, most whale meat they collect goes unsold because Japanese consumer interest in the protein has sunk dramatically since the 1960s (IFAW, 2013). On March 31, 2014 the International Court of Justice ruled to ban Japan's whaling program in the Southern Ocean where, since 1988, they have captured 10,000 minke and other whales annually (Tabuchi and Simons, 2014). The ruling does not pertain to Japanese whaling in other regions, which is slated to continue, but it is a symbolic step towards eliminating illegal and deleterious activity taking place in the oceans.

Around the world, whales have come to represent a connection to nature and a window into a novel environment (Kalland, 2011). Whale watching, a recreational, non-consumptive opportunity to observe cetaceans in their natural environment, is gaining popularity. It began around 1955 and has blossomed into an activity that 119 countries and an estimated 13 million people take part in annually (Herrera and Hoagland, 2006; IFAW, 2013). The industry employs roughly 13,000 people worldwide, earned $2.1 billion in 2009, and is becoming a lucrative alternative livelihood in developing countries (Cisneros et al., 2010). It is not an unalloyed good, however; heavy investment in ships and skilled labor and possible ship-whale collisions are

some of the costs of the enterprise (Kalland, 2011). However, for those who value whales more alive than dead, whale watching is a promising tool that may be combined with other conservation strategies.

Resource Units and Resource System. The biophysical context of whales strongly influences acceptability, participation, and feasibility of a whale market. Whale management is marked by a host of challenges because of cetacean biology and behavior. Firstly, whales inhabit the open ocean, making them common-pool resources that are non-excludable and subtractive. Second, they are highly migratory, which limits the capacity for institutions to effectively uphold proper incentive structures. Like other large marine species, whales are an integral link in marine trophic systems (Roman and McCarthy, 2010). The killing of a few individual whales has large impacts on their ocean-wide ecosystem. The magnitude of this effect has implications for species with long life spans and births of a few offspring interspersed over time, intimating that it could cause higher order effects at the community or ecosystem level (Lewison et al., 2004). These concerns are punctuated by heightening demand in growing economies, like China, where rising income corresponds to increased consumption of luxury food items, like fish and a variety of exotic products (Gale and Huang, 2007). Hence, individual animal welfare is connected to larger-level concern over populations.

Other salient threats to whales include bycatch, vessel strikes, pollution, climate change, plastic ingestion, disease, prey depletion, entanglement, and acoustic disturbances (Notarbartolo-di-sciara, 2013; MMC). Each is exacerbated by growing human populations, especially in coastal regions. Also, species stationed at the top of the food chain accumulate high contaminant loads,

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and cetaceans are always in a state of constant uncertainty because accurate population data is limited (Roman et al., 2013). One of the problems, excessive bycatch, elucidates the lack of enforcement troubling marine management. Since 30-40 years ago when targeted hunting was more prolific, the norm is now that non-targeted, yet deliberate catches are most common. Hunting overall has not relented because secondary catches are still consumed, targeted or not. The total capture rate, despite the method or intention, remains high and is motivated by ill-enforced consequences (Robards, 2011) due in no small part to whales roaming open access territory. The moratorium has eliminated commercial whaling except for loopholes, so it has been effective but could be strengthened.

Governance System and Outcomes. A full-fledged moratorium took effect in 1986 to serve as a temporary fix until catch limits could be implemented. The moratorium partly stemmed from the shortage of biological data and reservation over the acceptability of whaling. Buttressing the moratorium, today there are marine protected areas on the high seas and nationally defined marine sanctuaries (IWC, 2014). For example, the US has the National Oceanic and Atmospheric Administration's (NOAA) 1972 Marine Mammal Protection Act (MMPA) (NMFS, 2012). The MMPA placed a moratorium on all marine mammals, which encompasses 125 combined species of cetaceans and pinnipeds. It also prohibits the take of marine mammals within US waters, take by US citizens, and the introduction of marine mammals or their products to the US by non-US citizens. The MMPA was amended in 1994 authorizing controlled, incidental catches of marine mammals by fisheries operations. Whale populations have recovered since the moratorium and stringent measures like the MMPA, though the IWC's leverage on the international front is waning (SH, 2007; Roman et al., 2013).

If the reinstatement of whaling is judged favorably by popular vote of signatory nations, the IWC has prepared a scientifically robust plan called the Revised Management Procedure (RMP). The RMP was devised as a method to calculate safe harvest levels and advise on the sustainable harvesting of abundant populations using a catch limit algorithm by region, along with other harvest specifications. The majority of IWC members, however, currently approves of the moratorium (IWC, 2014). Still, releasing the ban in favor of a market would be aligned with stated objectives, and in fact, could be a short-term solution to hold over decisions on instituting the RMP. The working group on this policy was established in 1994. As demonstrated by the historical feedbacks between attitudes towards wildlife, scientific knowledge, economic drivers, and policy for whaling, it is important to understand how value systems factor in to a debate that has become dominated by ethical reasoning. Revisiting IWC policy is imperative to boost the institution out of a suboptimal, fixed pathway.

While policies operate on relatively short time scales, ethical approaches take a slower, more enduring route to change behavior. Until social and attitudinal shifts occur, an improved whaling regime can rectify divisive political views not by developing a single, uniform policy but by adopting a mixed-management system. As with the other CPRs, commercial whaling is enmeshed in broader social, economic, and ecological issues and processes, and must be dealt with sensitively. Even so, conscientious objectors to the moratorium are in the minority, so a market for whales is a curious imposition on a regime holding fast to all-out whale preservation. Most concerning is that starting a market could displace moral calculations with economic ones, and in doing so, stimulate a market that is already dissipating (Sandel, 2005; Minteer and Gerber, 2013; IFAW, 2013; Gerber et al., 2014[B]). As of writing, a market for whales is a concept in

circulation that finds patchy support among practitioners, scientists, and lawmakers. It remains a talking point in IWC meetings, as the Commissioner is well-informed on the proposition and has, by no means, blunted the idea.

Currently, the US Coast Guard and NMFS have not been able to adequately discourage violations in the way of bycatch, illegal killing, and oil and gas operations (Roman et al., 2013; MMC, 2012). To be sure, the IWC should remain the leader in international whale management. The presence of a strong leader can elicit better cooperation among involved parties, making progress more probable (Sandler, 2004). The IWC has overlapping interests in wild and endangered species with CITES, which entered into force in 1973 to conserve the world's biodiversity. With its network of 178 member nations (compared to 89 IWC members), observer delegates from NGOs and IGOs, and scientists, CITES can assist the IWC mission in collecting and disseminating information on marine species and tracking stakeholder exchanges associated with the wildlife trade. In 2013, CITES met to consider adding traded marine fish to the list of species they protect, which further validates the prospective role of CITES in marine megafauna management (Vincent et al., 2013). Though there is CITES relevance to involving and other multilateral agreements, such as the IUCN and the Convention on Conservation of Migratory Species, these agreements can only be followed voluntarily and invariably confront the same issue of compliance as the IWC.

Market Futures for Marine Species. The institutional hurdles of markets for cetaceans do not diminish the potential for market mechanisms to regulate harvest of other marine megafauna (i.e. sharks, sea turtles, and rays). Because these species inhabit existing fishery zones

(and are at risk because of intensive human activity), they are more amenable to rights-based management. In fact, species that have a limited range, like gray whales (*Eschrichtius robustus*) that stay within EEZs of the North Pacific and the Northeast Atlantic minke whale (*Balaenoptera acutorostrata*), could be managed via the implementation of property rights. NOAA employs a number of tactics to "protect marine resources and their habitat and help safeguard the health of seafood consumers and the livelihoods of coastal communities" (Fisheries, NOAA, 2013). In addition to programs like protected areas and habitat conservation, NOAA seeks to expand catch share programs, and it is currently considering them for other marine megafauna (e.g., Atlantic sharks (NMFS, 2011), Baja sea turtles (Senko et al., 2013)), which highlights the emerging importance of wildlife markets in marine settings. Instituting systems of compensation or catch shares where quotas are already in place for large marine species, such as sharks and sea turtles, could be an improvement to the efficiency and accountability of marine regulation and other at-risk, near-shore marine populations (Essington, 2012).

CHAPTER 5

SYNTHESIS OF CASE STUDY FINDINGS

The SES framework highlights the relationship between the biophysical backdrop of a given

CPR and the policy arena. Acknowledging the inextricable link between social and ecological

endeavors is inherently complex, so Ostrom encouraged designing governance to suit system

complexity rather than dampening it. For a CPR scenario yielding suboptimal outcomes in which

the biophysical conditions and the attributes of the community are effectively locked-in, the

institutional design must change (Dietz et al., 2003). To do so, actors should reformulate their

collective agreements to perform better, and in conservation, this means considering alternative

pathways for species management. The case studies just described shed light on the feasibility

and acceptability for wildlife markets to serve a role in SES governance. I extracted the SES

second-tier variables relevant to wildlife markets (Table 1) and describe the relationships

between the four core subsystems (Figure 3).

Long-term sustainability of a wildlife population and the institution governing human activity

depends heavily on rules matching the attributes of the resource system, resource units, and

users. Based on this reasoning, in this section, I provide an overview of common features across

the case studies that showed to be particularly important for whether the institution is relatively

successful or not. This rote categorization as a success or failure is a simplification of the

complex situations of wildlife management. Nonetheless, it aids in my goal of diagnosing the

strengths and weaknesses of the SES system, which would allow me to later examine those
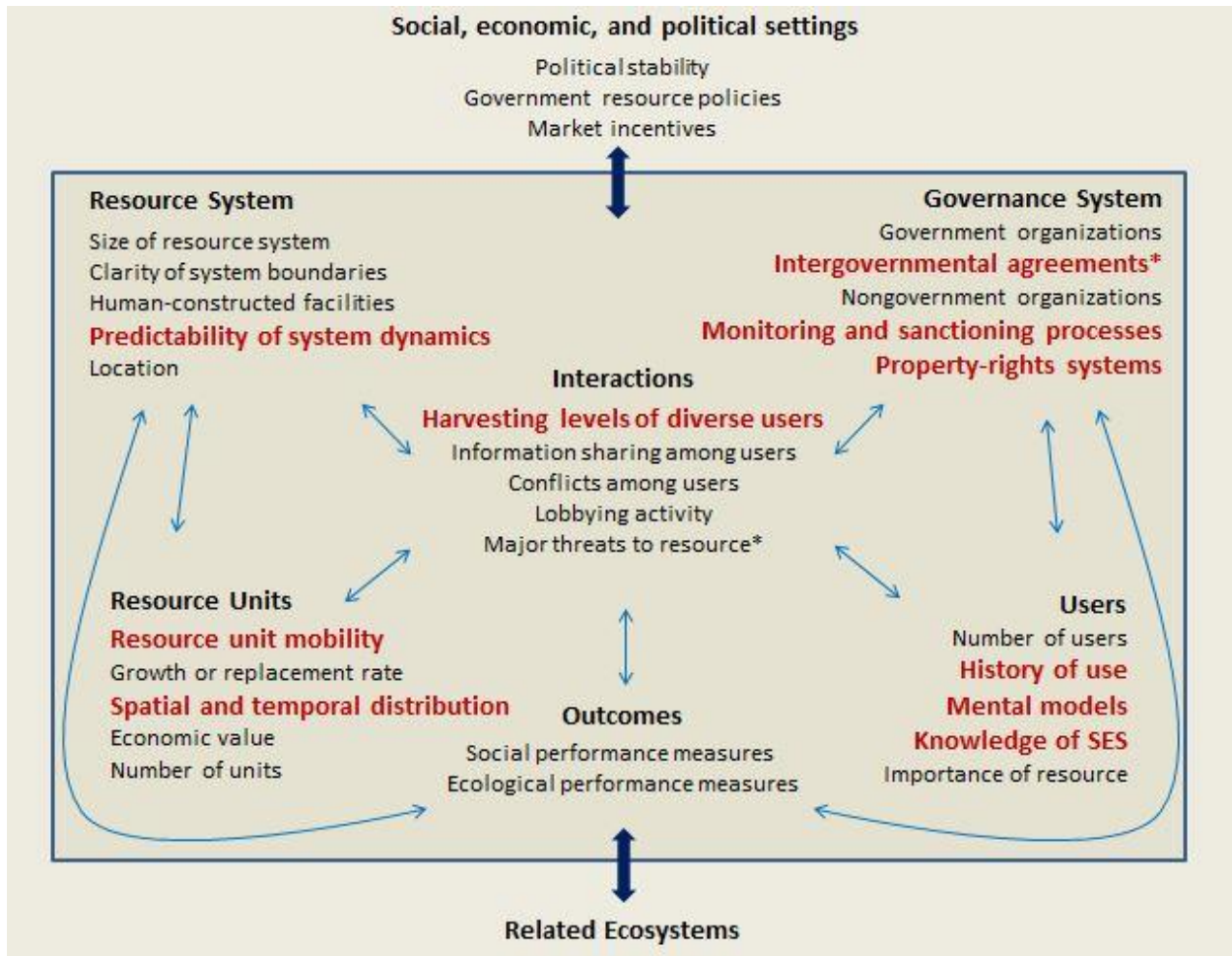
linkages more closely.

Figure 3. Relevant second-level variables and interactions between core subsystems for wildlife markets. Adapted from the Social-Ecological Systems framework (Ostrom, 2009). Highlighted in red are the variables found to be most important for the success of a wildlife market. An asterisk indicates a feature unique to this analysis that is not part of the original framework.

Table 1. Wildlife market case studies characterized using subsystem variables of the Social-Ecological Systems framework. An asterisk indicates a feature unique to this analysis that is not part of the original framework. Adapted from Ostrom (2007).

Subsystem Variables	Case Studies			
	Whales	**White rhinos**	**Bighorn sheep**	**Atlantic Bluefin tuna**
Resource System (RS)				
Size of resource system	large	small	herds inhabit a small area; the population covers a large	large

			area	
Clarity of system boundaries	yes; territory for each species is generally understood	yes; fenced parks or game ranches	yes; territory in parks and public lands is generally well mapped	yes; territory is generally understood
Human-constructed facilities	none	yes; park buildings	yes; park buildings	no
Predictability of system dynamics	low	high	high	intermediate
Location	global	South Africa, Namibia, Zimbabwe, and Kenya	western US, southwest Canada, northern Mexico	Atlantic Ocean
Resource Units (RU)				
Threats*	habitat degradation, disease, hunting, climate change, fisheries interactions	encroachment, habitat degradation, poaching	disease, encroachment, habitat degradation, poaching	habitat degradation, overharvesting, bycatch
Resource unit mobility	High; depending on the species, individuals move thousands of kilometers in a single year	low	Intermediate; herds are non-migratory but disperse seasonally	high; individuals move thousands of kilometers in a single year
Growth or replacement rate	slow	slow	slow	slow
Economic value	intermediate (regionally)	high	high	high
Number of units/ status	statuses varies; many populations are growing	near threatened (IUCN) 20,000	least concern (IUCN); endangered (ESA) >70,000	endangered (IUCN) (stock size uncertain)
Spatial and temporal distribution	global	local	local	regional
Users (U)				
Number of users	13,000 employed and 13 million (average) participants in whale watching yearly; few nations cull whales	18,500 hunters per year in sub-Saharan Africa; thousands of photo-tourists	11.6 million people participated in big game hunting in the US (2011)	thousands of consumers of tuna meat
History of use	once heavy, now isolated	fluctuating but heavy	management keeps rates low	heavy
Mental models (ethics)	moral obligation -- utilitarian	moral obligation -- utilitarian	mostly utilitarian	entirely utilitarian
Knowledge of SES	some data but varies by species; generally incomplete	complete	complete	generally incomplete
Importance of resource	socio-cultural, minor subsistence	socio-cultural, ecotourism	socio-cultural	commercial

Governance System (GS)				
Government organizations	varies by country; NOAA in US	South African National Parks	Department of the Interior and state agencies	varies by country; NOAA in US
Intergovernmental agreements*	IWC	CITES	none	ICCAT
Nongovernment organizations	Animal activist and conservation NGOs	Animal activist and conservation NGOs; hunting organizations	Animal activist and conservation NGOs; hunting organizations	conservation NGOs
Property-rights systems	none	private land owners; hunting permits	hunting permits	fisheries catch shares
Monitoring and sanctioning processes	none that are formal; social enforcement	penalty for poaching is a fine and prison	penalty for poaching is a fine	none that are formal; social enforcement
Harvesting levels of diverse users	Japan: high; Norway and Iceland: moderate; subsistence: low	high poaching rates	low hunting rates	high: countries bordering Atlantic and Japan
Conflict among users	yes; over compliance and moral permissibility	yes; profit distribution	yes; human-induced selection pressure	yes; over compliance
Lobbying activities	anti-whaling	anti-hunting	anti- and pro-hunting	higher harvest quotas

Users. From the SES variables, mental models, history of use, and knowledge of the SES are the most important determinants of institutional success. Stakeholders whom would ideally become shareholders in a market espouse a mixture of environmental attitudes that manifest in diverse preferences for types of species management. Generally, there are distinct camps of actors: those who seek to preserve animal populations and those that would elect to harvest them. Within each of these designations is a spectrum of viewpoints regarding the use of animals, spanning from animal welfare advocates and conservation scientists to subsistence and commercial harvesters. Stakeholders also include recreationists, local advocates, and larger scale conservation groups. Support for mammal preservation, especially mammals perceived to be charismatic, is often deeper and more vocal than that for other taxa, like reptiles and

invertebrates (Kellert, 1983). Universal compliance, however, is rare when dealing with shared resources, especially for resources that raise deep ethical quandaries, like charismatic wildlife (Minteer and Manning, 1999). In fact, the moral acceptability of markets for such species has implications that are subject to scrutiny.

Preservationists motivated by ethical commitments to species protection suggest that a market for wildlife fails to account for hidden costs and benefits and that it simply buys into the narrow view that wildlife should be valued for their economic ends. Minteer and Gerber (2013) examined the issue of whether we should consider markets for whales and other species in light of widely held views about their ecological and ethical significance. Although markets could appease a fraction of stakeholders oriented towards the monetary facets of natural resources, it is also possible that commodification of a non-market good erodes our moral commitment to non-human species. The inappropriate use of wildlife markets risks undervaluation of the targeted good by preventing proper expression of a fuller set of values towards non-human nature (Sandel, 2005). In response, one could question whether it matters that a market misses the full spectrum of values for whales as long as it works for conservation and does not undermine the capacity for other values (including moral values) to be realized (Minteer and Gerber, 2013). Other concerns about wildlife markets voiced are more economically focused, which Gerber et al. address (2014[B]). For example, conservation market critics assert that some resource users object to markets and would not participate while others may free ride on the contribution of like-minded stakeholders and opt out of a market, leading to sub-optimal outcomes. If conservation organizations overtake the market, wildlife shares would essentially become buyouts for harvesters (Gerber et al., 2014[A, B]).

I suspect that private individuals and organizations seeking to preserve wildlife fall onto a sliding scale of environmental ethics that dictate market participation. On one end reside parties that are morally compelled to protect wildlife and hold all or some species in the highest moral regard. Those of this conviction reject a market, believing animals transcend this type of valuation (Nunes and van den Bergh, 2001). Some safari tourists, whale watchers, and even people who will never have these experiences vehemently oppose any killing. The other side consists of parties that are motivated to conserve species, and embrace nontraditional methods of conservation among other strategies. This type of scenario can be expected should a wildlife market, as described for whales, be enacted. Placement of stakeholder groups along this continuum can only be accomplished through interviews to elicit ethical and behavioral responses.

In some of the preceding case studies, actors shared a common mental model for how to use wildlife sustainably, if use is desirable at all. This was exemplified by hunting organizations, wildlife managers, state agencies, private landowners, and hunters whom are the primary actors in Bighorn sheep management. Relatively little concern is voiced by conservation NGOs and animal rights activists for Bighorn sheep relative to white rhinos and whales that strongly advocate non-anthropocentric viewpoints. It is clear that ethical and moral arguments against consumption of Bighorn sheep, rhinos, and whales and markets that condone such behavior are much louder than those for less charismatic megafauna, like fish. For species that are less charismatic, we would expect the extent of free riding to be more severe, suggesting even more limitations of the use of catch shares to conserve non-extractive uses of wildlife (Smith et al.,

2014). Stakeholders of big game and cetaceans are international, whereas those of bighorn sheep are mostly in the US with some in Mexico and Canada. More international representation perhaps brings with it a greater breadth of perspectives in decision making. High stakeholder heterogeneity can promote comprehensive and diverse planning, but in this instance, abject differences prevent convergent policies. Heterogeneity may also increase transaction costs if there is less trust and more conflicting viewpoints (Sandler, 2004). Ethics will not preclude the formation of a market for wildlife, as evidenced by white rhino management, but they will influence interactions and outcomes.

The importance of the resource to the community impacts what policies are acceptable and likely to succeed. Struggling economies in South and East Africa prioritize strategies for protecting wildlife that offer financial benefits to fuel local communities. That the recovery or sustainability of wildlife can pay for itself is a shared theme woven into the philosophy of big game markets. For species often seen as pests, as demonstrated by the case of white rhinos, there is an urge for local community members to kill animals rather than work with wardens to remove them. This heightens the need for proper enforcement. With top-down regimes, policing power comes at a cost without a sufficient source of revenue to support paying for those jobs and may ultimately disincentivize cooperation. Still, all policy must rest on a good scientific grasp of biology. The amount of available scientific knowledge varies by species. Bighorn sheep are still notoriously difficult to count due to scattered herds in hard to reach places (Monson and Allen, 1980), and pelagic species, by virtue of their location, are not well-studied. This information should be disseminated to consumers and the immediate community that is likely to interact with wildlife to form the basis of actions towards wildlife. The design of the rules, which take into account

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user demands, must rely on knowledge of the SES to foster good stewardship or else actions may be detrimental to the resource.

Governance System. The governance variables that stand out in wildlife management include intergovernmental agreements, monitoring and sanctioning processes, and property-rights systems. Well-established policies are hard to change, as institutions that have matured over time are reinforced by instilled cultural and social practices and norms. 'Historical institutionalism,' as this phenomenon is termed, "conceives of public policymaking and political change as a discrete process, characterized by extended time periods of considerable stability - referred to as "path-dependency" - interrupted by turbulent, 'formative moments'" (Peters et al., 2005, p. 1276). Path dependency refers to the notion that an existing policy or similar ones tends to be favored over dramatic shifts. Incremental changes to the status quo, however, limit responses to better policies. This term has been used when referring to climate change (Shove, 2010), energy technologies (Unruh, 2000), and health care (Wilsford, 1994). Incrementally, an institutional context may evolve into a market-friendly environment, but evolution takes time. Feedbacks move more quickly between outcomes of a social-ecological system and deliberation processes (e.g., setting the quota and allocating shares), whereas a lagged response occurs between outcomes and contextual variables (e.g., attitudes, values, and policies).

South Africa's conservation model since the 1960s integrates tourism and hunting towards economic ends and they are unlikely to forfeit this income generator for Kenya's strictly non-consumptive practices. Likewise, North American hunting crowds are reluctant to make changes for fear of memberships being revoked or increased work for practitioners. Decision-makers

limit themselves to the pool of possibilities that when assessing the success of policy is done by narrowing the policy alternatives to ones that are similar to the status quo and then studying how their consequences differ (Lindblom, 1959). To this point, the legal trade of rhino horns was pitched two decades ago in COP Cites 8 (Milner-Gulland and Leader-Williams, 1992) and is still contentious particularly between countries with conflicting models of conservation. The proposal for a whale market has been in circulation for just two years. How long will we debate the merit of this program for whales before action is taken? Parties are averse to change if current state is adequate and cost efficient (Libecap, 1993). Resource users that are satisfied with the status quo will likely be opposed to property rights that detract from their current benefits or at least the adoption of a new policy will elicit lobbies.

Alternative sources of benefit to compensate the community and prevent assaults on wildlife are necessary (Hemson et al., 2009). Conrad (2012, p. 250) submits that, "some data suggest that animals on privately-held land suffer less poaching and overexploitation because of vested economic interests." By installing property rights, "costs associated with protection are transferred from the social to private sectors" (Conrad, 2012, p. 250). Top-down control mechanisms that prohibit all use of wildlife increase the importance of enforcement but also make it more difficult and expensive, begging the question of whether alternative routes to protection, albeit controversial, trump standard operations. Command and control regimes are typically too rigid to cope with unpredictability of natural systems. Markets are more dynamic and can conform to human behavior as preferences and resource availability changes (Holling and Meffe, 1995). The conservation of threatened game species and habitats is successful when

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markets are organized so that buyers of permits value the resource more highly than sellers of permits (Schuhmann and Schwabe, 2000).

For Bighorn sheep, this has been achieved by the issuance of tags and quotas in some areas partnered with protected areas in state and federal parks. South Africa marries non-consumptive ecotourism with sport hunting industry, an alternative that involves extraction. Trophy hunting is prominent for Bighorn sheep, as well, but these animals are not the main attraction for visitors to US parks as big game are on African safaris. Legalizing the creation of property rights to wildlife can channel the generated wealth back into protection efforts. Markets may also be appropriate and particularly useful for populations located in places where tourism is not possible.

In other situations, exploitation is desirable but, in the absence of a tourism industry, there remains forward-looking economic interest in saving the species from decline, as with Bluefin tuna. The benefits of devolving rights must outweigh costs of proper and effective implementation and enforcement. Limited entry is less costly than open access but, simultaneously, this may impose external costs on others (Schuhmann and Schwabe, 2000). Marine fishermen can often dissent with impunity because the biophysical context enables it. Policing in terrestrial settings is measurably easier because the resources are on governed and bounded territories; animals and user activity are more visible this way. In fact, the global commons are nearly impossible to manage well. The capacity of institutions at any scale to monitor and sanction activity that occurs on the open ocean is low and the expense of providing that public infrastructure is lofty. Unilateral action will not be affective solitarily. Domestic policies, like the MMPA, can jumpstart discussions abroad and expand into comprehensive

conservation agreements that retain the standards of a successful national program (Pannel, 1990). Perhaps most obvious in the assessment of existing and potential wildlife markets is that whale and tuna management is less effective compared to that of bighorn and rhinos because of governance enabled by clearly defined jurisdictions in the later cases.

Some prohibitory features of a market, therefore, are shared by all policy attempts to govern the marine commons no matter the strategy or species, while other policy nonstarters are unique to whales because of their special moral status. Today's premier document on fisheries regulation, the Magnuson-Stevens Fishery Conservation and Managements Reauthorization Act (MSRA), was signed in 1976 to bolster fisheries management and protect marine resources, particularly from illegal activity. MSRA is infused with a mix of economic, social, and biological directives (Doremus, 1997). But this only applies to national waters. MSRA was last revised in 2006 and expired in 2013. With a pending amendment for 2014, the next version of MRSA is expected to forbid new catch shares programs in certain regions (US Congress, 2013). Without a market mechanism, other recovery strategies are being explored for fisheries management. Property rights constrain the amount of extraction, but limiting fishermen effort can subsequently reduce the total resource yield. "Where, when and how to harvest" is easier to police than how much (Anderies and Janssen, 2013, p. 524). Gear modifications reduce bycatch and entanglement and time limitations cut down on vessel-wildlife interactions and harvest volume (MMC, 2012).

     Interactions and Outcomes. The deliberation processes for designing markets hinge on the fair and transparent allocation of quotas (North, 1990). A market to protect exploited species is only as effective as its well-defined TAC calculated from scientific and quantitative models of

species data. Efficient allocation of the TAC settles competing demands between users and minimizes costs, but the level of the TAC itself is the aspect most responsible for protection. These contracts between users are based on harvesting levels of diverse users, and, in a whale conservation market, would change from year to year based on whether the market is dominated by use or nonuse values.

Appropriating shares in fisheries, as a conservation market for whales would emulate, can be a political battle. It is based on either 'grandfathering', the most typical arrangement, and/ or auctions (Arnason, 2002; Pinkerton and Edwards, 2009). Anderson et al. (2010) assert that grandfathering, which grants rights based on past participation, is a more efficient mechanism than alternatives for quota allocation. Incumbents, they argue, have more experience and better knowledge of functional aspects of the fishery, leading to better outcomes. Although in this scheme auctioned shares will land in the hands of the highest bidder and reap a higher profit, these investments may be retained in the long run, posing a risk to the CPR. Inclusion of the grandfather provision, in contrast, still allows new users to engage, which would be obligatory in a whale conservation market because conservationists, who traditionally have not had access to shares of the TAC, would have the option to purchase rights. Rights would have to be grandfathered to whalers because historical users own the equipment and have the skill to whale, as this is a time- and resource-intensive endeavor. However, whaling has been banned since 1986 and earlier for certain whale species, so those who have not been culling whales should not suffer for abiding to the moratorium, despite having the preference to hunt during that time period.

Effectively appropriating shares also bears on lobbying behavior and users' obedience to the rules, which stem from their perception of and satisfaction with the process (Morgan, 1995). As in fisheries, it is probable that lobbying to increase the TAC or effort to increase one's apportioned rights of the TAC will ensue (Grafton et al., 2005). Accordingly, the appropriation of shares should be wholly considered prior to forming a conservation market for whales because of the unique issues that arise as a result of lifting the moratorium and permitting access by conservationists. In deliberation, good decisions will equally weigh social (i.e. allowing users to actualize the value they place in a resource) and ecological objectives (i.e. ensuring a sustainable population and ecosystem). Economics of fisheries drives human behavior to a greater extent than can be expected for markets in big game and whale management where the aims have shifted to a focus on entertainment and non-consumptive value rather than solely extraction.

Resource System and Resource Units. Location, spatial and temporal distribution, and resource unit mobility affect the ease of assessing ecological parameters of the resource system and monitoring user behavior. White rhinos fall within one jurisdiction, Bighorn sheep as an entire resource system span multiple but herds remain within localized areas, and Bluefin tuna occupy multiple jurisdictions as well as international waters. Unlike sovereign nations with the power to assign property rights, no authority exists to do this for international public goods (Perrings, 2014). Access rights hold resource users accountable to the consequences of their actions, an essential ingredient for viable markets. In addition, system dynamics need to be sufficiently predictable that users can estimate what would happen if they were to establish particular harvesting rules or no entry territories (Ostrom, 2009).

Agreements among nations may function well if animals occupy only national jurisdiction. Since property rights are unreasonable in some settings, wildlife that crosses borders requires other conservation techniques. Rather than policing an entire species' range, efforts can be concentrated in sensitive areas where animals reside during critical life stages. Take, for example, the olive-sided flycatcher (*Contopus cooperi*), Wood thrush (*Hylocichla mustelina*), and Golden-winged warbler are among the over 300 species of Neotropical birds that winter in tropical rainforests and mangroves of Central and South America and spend the summer months in North America. Habitat loss and fragmentation are their greatest threat, though poaching that supplies the exotic pet trade and demand for plumage is also a real concern (NPS, 2010). Perhaps the best strategy is to safeguard the summer grounds where these animals nest and forage.

The same paradigm may apply to Bluefin tuna if managers focus on protecting critical spawning grounds. Concentrated efforts on lowering mortality rates of young and reproductive-age adults can help restore populations. Similarly, African elephants (*Loxodonta*) move across continents and are important shapers of ecosystems, creating edge habitat, controlling vegetation, and fostering biodiversity. Their historically expansive migrations are now limited by enclosed parks, ranches, and human development, necessitating diverse, multi-scale regulatory regimes to match the multi-faceted problem. HMS, like bighorn sheep, whales (e.g., Humpbacks (*Megaptera novaeangliae),* which undertake longest migrations of any mammal), and Bluefin tuna, would benefit from migratory corridors to move safely between feeding and breeding areas.

CHAPTER 6

CONCLUSION

Proposals for a 'new' type of conservation (Kareiva and Marvier, 2012) are ushering in novel ideas for how to balance the needs of people and nature. Wildlife markets are a potential course of action to broker a deal among stakeholders in a charged climate, like natural resource management, and to protect inherently and economically valuable species from demise (Mills, 2012; Perrings, 2014). Ecological degradation and species loss are more probable in the absence of markets to convey signals of their value and to encourage positive long-term stewardship (Fujita, 2013). The rapid diversification of markets over the last 30 years makes a compelling case for the relevance of such solutions in wildlife conservation discussions. The motivation to pursue this path is based on economic theory that validates its likelihood of success judged against conservation benchmarks (Gerber et al., 2014[A,B]) and the experience of existing markets for megafauna worldwide that justify the role of property rights in saving jeopardized species. Presently, wading through the thick of these decisions is deficient and would benefit from the SES framework presented here for assessing markets for specific species and settings.

The qualitative analysis I conducted is limited to describing rather than quantifying the relationships between the SES core subsystem variables to identify weak links in the case examples of wildlife markets. To expand this institutional perspective, complimentary approaches may be taken that would allow me to disentangle remaining ambiguity in the cases. Such approaches to test the weak links I identified could entail using differential equations, agent-based modeling, or bioeconomic modeling to tackle questions about various aspects of wildlife conservation markets, such as outcomes yielded by exploring different scenarios of

governance and enforcement. Drawing on a more comprehensive set of literature would allow

the evaluation started here to have even more utility in conservation policy circles.

Marine resources are a critical asset to commercial and subsistence interests worldwide for

nutrition and income; yet, they are inadequately managed relative to their demand and

importance. The problem of overexploitation arises from constraints inherent to marine resources

and aspects of marine megafauna biology (e.g., low reproductive rates, long-ranging migrations,

unique histories and relationships with humans that evoke strong preferences) (Hirata, 2004;

Roman et al., 2013). Most notably, there is no authorized jurisdiction of the open ocean and there

is limited available knowledge on marine wildlife. The latter should not preclude moving

decisions forward, though it does retard the process. In addition, high stakeholder heterogeneity

can promote comprehensive and diverse planning, but in this instance, abject differences may be

prolonging the policy standstill. Because of these factors, solutions to successfully govern

cetaceans and other highly migratory marine species have generally evaded policy makers. Any

robust institutional arrangement must acknowledge the limitations of governing marine resources

and complement the highly variable attributes of the global community.

Conservation wildlife markets can be successful in any jurisdiction provided cultural and ethical

sensitivity, adequate monitoring and sanctioning, and thorough knowledge of the resource and

resource system. Mired by controversy, global whale management has much progress to make by

way of improved policy decisions that replace the currently tenuous moratorium on commercial

whaling. Considering the costs and benefits of rights-based management on the high seas, a

market for whales does not appear advisable. Reports of recovering whales stocks over recent

decades are encouraging, and if demand for whale meat is both isolated and declining naturally, the spur for a market for harvest rights may be inappropriate unless IWC members vote to reestablish commercial whaling. A market for whales raises a host of ethical and socio-economic questions that are not worth stoking if the gains a whale market may reap are inferior to the costs of enforcing conservation. Markets as a tool have merit but are limited by the ecological, social, and economic conditions under which they operate. Given this, wildlife can be better managed using several strategies wedded with a market approach, at least temporarily, to better capture all values of the resource.

No-take zones coupled with quota-based systems where whaling persists is worth continuing, seeing as it echoes the majority of both preservationist and harvest-minded stakeholders. Wildlife conservation markets should be explored more in-depth for alternative marine megafauna because of the multiple stressors from which they suffer and the opportunity to ally with existing fisheries that enlist catch share programs. International partners, like CITES, should be prompted for collaboration alongside fisheries managers and the IWC in order to improve rates of abidance to the rules. Questions that should be bookmarked for whale management are: Why do whaling nations (i.e. Iceland, Norway) opt out of international collaboration, and why does Japan continue to nurse a dated industry? More generally, empirical studies would add to our understanding of the situation.

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